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University of Pennsylvania

THE WITMER FORMBOARD

By
Herman H. Young

An Abstract of a Thesis
Presented to the Faculty of the Graduate School in
partial fulfilment of the requirements for the
degree of Doctor of Philosophy.

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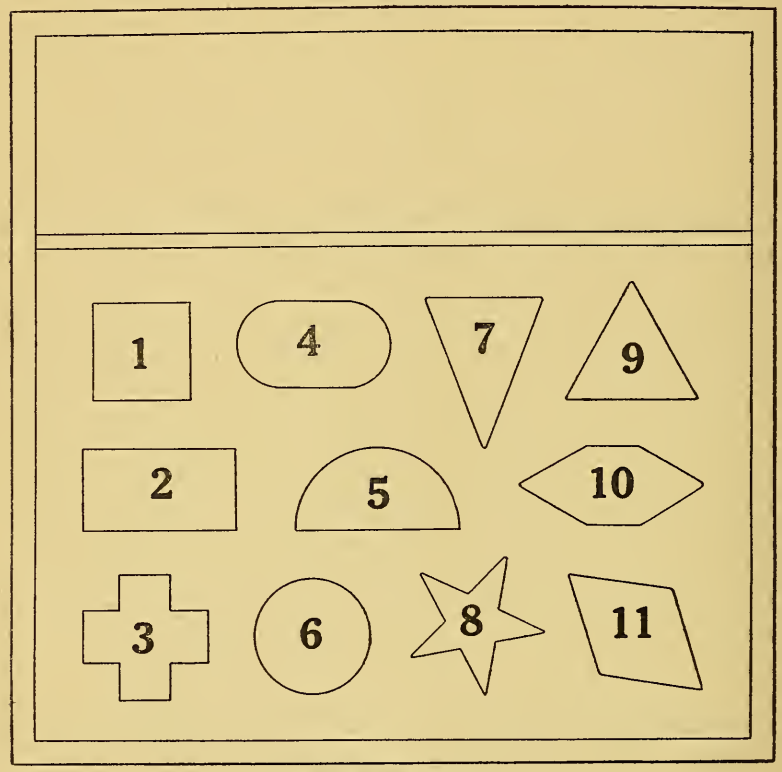
THE WITMER FORMBOARD.

In its various modifications the formboard is in general use among clinical psychologists, and appears to have won a permanent place among the tests to be regularly employed in clinical laboratories. It is a developmental outgrowth of the simpler contrivances first used by Itard and Seguin for training purposes.

The formboard used in this investigation differs in size, number, and arrangement of blocks from any heretofore described. It is Dr. Lightner Witmer's final modification of the formboard described and standardized by Dr. R. H. Sylvester [6]. The Witmer formboard was adopted to replace the older types, only after careful and extended experimentation in which many other variations in size, number, and arrangement of blocks were applied to children in the Psychological Clinic and to students in psychology at the University of Pennsylvania. It was the opinion of those concerned that this smaller board has all the advantages of the older and larger boards, and in addition has qualities which make it more desirable as a test. It is more attractive, looking like a toy or puzzle. Both boards were given to a number of children, alternating them on successive trials. When the children were asked which board they preferred, the answers were predominately in favor of the smaller board. This smaller board also makes a much more convenient piece of apparatus, as it does not take up so much store room and is very easily carried about. Moreover the addition of an extra block makes it a slightly more complicated test.

The Witmer formboard contains eleven geometrical figures as nearly uniform in size as their variety of form will allow. The square block in the upper left hand corner of the board is one and a half inches on a side by half an inch in thickness. All the blocks are the same thickness. The recess on the board corresponding to each block is just enough larger than the block to permit it to be fitted in loosely, *i. e.* easily without becoming wedged in place, yet

with but little play. The depth of each recess is one-half that of the blocks, so that the blocks when in place extend one-fourth of an inch above the surface of the board. The blocks and their recesses are of such size and shape that no block can be fitted into any recess other than its own; in other words, the board is self-correcting.



THE WITMER FORMBOARD.

The entire board, including the raised edge on each side three-eighths of an inch wide, is one foot square. The surrounding edge fits flush with the back of the board, but extends one-fourth of an inch above the face of the board or even with the blocks when in place. At the top a tray extends across the entire board, three and one-fourth inches wide and one-half inch deep, or as deep as the blocks are thick. Both board and blocks are neatly stained, the board being light oak and the blocks walnut, while the recesses are painted black. This produces an effective contrast between board, blocks, and recesses.

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The tray at the top of the board is a receptacle for the blocks when removed from their recesses. It determines definitely where the blocks are to be placed and insures that they shall be within reach of the subject throughout the test. When the examiner wishes to carry the board with him from school to school, the entire face of the board may be covered by a lid made for the purpose. In this case the record blanks are carried in the tray.

It is only within the last few years that the formboard has been extensively used as a testing device. During its short history it has undergone many alterations and modifications, so that in its present form and appearance it is as remote from the original as the purpose it subserves, having been first used in training subnormal children. In none of its developmental or final forms has a reliable and comprehensive standardization ever been carried to completion. A number have been attempted, several hundred children tested, and the results labeled "Standardization;" but without exception the range of variations has been entirely too large for the number of cases tested. The investigations thus conducted are, however, not to be discredited and pronounced valueless on this account. Their defect is one of omission rather than of commission. A complete and reliable standardization will require the testing of many thousand normal children and adults.

Perhaps the most constructive piece of work done with the formboard is that by Dr. Sylvester [6]. His standardization is subject to the criticisms made above, but certain features of his work have served as the basis for more recent investigations. In the first place he demonstrated the necessity of giving at least three trials. He showed that three trials were sufficient reliably to determine the subject's formboard ability and that more trials would be of little value, *i. e.* the time spent would be out of proportion to the accuracy gained [7]. In the second place he showed that of these three trials the shortest constitutes the most reliable single index of the subject's formboard ability. This does not mean that it is an infallible guide, but that on the whole it is more accurate than any other single feature, even than the average of three trials [8]. In the third place, he demonstrated that the number of errors made by normal children is too few to have value in the establishment of standards, and that their average shows no consistent correlation with age [9]. Another significant fact revealed by this same investigation is the negative correlation between age and the time required for replacing the blocks [10]. This clearly demonstrates the fundamental basis upon which a satisfactory standardization can be made. Other considerations discussed indicate that the

time feature of the test constitutes the only definite basis for the establishment of norms.

It is around this latter feature of the test that most of the experiments and discussions concerning the formboard center. It would take us too far afield to attempt a review of the literature now available on this topic. Aside from the standardizations, as they have been carried out so far, the above summary of Sylvester's work includes the important features now generally recognized. There are several minor investigations, but they do not advance beyond what Sylvester has done. As they merely serve to establish more fully the importance of the test, they will be referred to in the bibliography or in the text as occasion may require.

If now we turn from the past to the present and look to the future development of the formboard test, we see at once that most of the real work is yet to be done. We have not even a reliable age standardization at our command. It appears evident, as stated above, that an age standard is the easiest to establish, and so far as discovered is the only one possible at present. Attempts have been made and are being made to correlate formboard ability with other mental traits and capacities, but no conclusive results have yet been produced. This failure is, perhaps, due as much to the inadequacy of the method and the indefiniteness of the various mental traits and acquisitions with which correlation is attempted, as to any defect in the formboard test. We cannot hope to get significantly conclusive results from comparisons until the mental processes and traits compared are more precisely defined and proved to be simple and elementary, instead of complexes. Too often attempts are made to compare incommensurate qualities.

The considerations just summarized have prompted the present investigation and determined in general the scope of the work attempted. It was undertaken and completed as a preliminary and basic outline of a series of comprehensive investigations and reports to be made on this one test. The reasons for calling this a preliminary study and avoiding dogmatic conclusions and interpretations have steadily gained weight as work has progressed. Problems and possibilities were opened which indicate roughly the extent and character of the necessary future investigations for the establishment of reliable norms of even the simplest sort and for finality in any sense.

A glance at the distributions of the time records shows that the norms here established are only approximately correct, and that with two or three times as many records they might be considerably shifted. As in all preceding investigations, we shall also

see that there is a consistent negative correlation between time and age up to the ages of fifteen or sixteen at least. Up to the age of thirteen, half-year groupings are necessary. It is possible that further investigations will show these groups to be too large. A second conclusion for which we have considerable evidence, is that in general there is a sex difference in formboard ability in favor of the boys. At present we must be content with these generalizations. Just what the differences are from one age to the next and just how great the sex differences are, must be left for future investigators to determine experimentally.

Until age norms for the two sexes, separately, are more reliably determined, *i. e.* until these simplest of correlations have been made, other possible and attempted correlations must necessarily suffer a severe handicap. With age norms and sex differences established, we would have the essential material at our command to attempt other comparisons, such as formboard ability with class standing, with manual training, a mechanical turn of mind, or with vocational adaptation.

Method.

The test is presented by exactly the same method to all subjects, whether they be normal or defective, children or adults. Even though the conditions here outlined may appear trivial, they are in certain cases of great importance. If they are not carefully observed and standard conditions maintained throughout, a failure or poor record on the part of the subject may indicate the examiner's incompetency rather than the subject's inability. The sad thing about it is that in the permanent records, it is marked against the subject.

Height of the table. The height of the table upon which the board is placed is the only variable. This is to be suited to the convenience of the individual tested, the aim being to have the board at such a height that the subject can perform the test to the best advantage. It is necessary that he be able to look down upon the board. If he can barely see across the top, he is compelled to work at a disadvantage, as he cannot see the recesses properly and cannot use his arms and hands freely.

Position of board on table. The board is placed horizontally on the table with its lower edge (edge opposite tray) even with the edge of the table nearest the subject. It is very important that the board be kept in this position and be constantly watched. In his attempts to hurry, a subject will often move the board about considerably, sometimes getting it out over the edge of the table

where it may tip and fall to the floor, and sometimes pushing it back from the edge until only with difficulty can he reach the blocks in the tray.

Position of subject. The subject is always required to stand directly in front of the board throughout the test. In fact he is required to take a correct position with respect to the board before the directions for the first trial are given. This position is insisted upon, because it gives the subject more freedom than any other in moving about during the performance of the test. He can readily adapt his position to see to the best advantage both blocks and recesses, and has unlimited freedom in making the movements necessary to place the blocks quickly in their proper recesses by the use of either one or both hands. It also gives the experimenter opportunity to set the table and board in the best light and be sure the subject will not have to work in his own shadow. The subject should always have the advantage of the best light available.

The standard method. The subject is introduced to the test with as few directions as possible. The standard method gives all that it is necessary for him to know. It is purposely intended to throw the subject upon his own resources and allow him the greatest opportunity of showing what he is really able to do. He is given no negative or "Thou shalt not" directions. The directions are all positive and active. In no case is he given any help or suggestions other than those included in the standard directions. Inability to follow the standard directions or complete the test correctly without additional instruction constitutes a failure. These failures will be treated elsewhere as a separate investigation. The entire test consists of three trials given in as rapid succession as possible.

First trial. As soon as the experimenter knows who the subject is and the position has been taken before the board, he says to the subject, "I am going to take these blocks out and put them up here. I want to see how quickly you can put them back where they belong." While giving these directions the experimenter removes the blocks from their recesses and distributes them in a haphazard arrangement in the tray at the top of the board, *i. e.* he begins to remove the blocks at the same time he begins to speak, but usually finishes speaking before the blocks are all removed. Then after the blocks are all removed the experimenter continues the directions thus, "You may use both hands, and *work* just as *fast* as you can." This is generally sufficient to induce the subject to begin replacing the blocks at once. If he hesitates with an air of uncertainty, as if waiting for the "ready" signal, the experimenter may add, "You

may begin as soon as you are ready," or "Go ahead," or "All right," or "See how quickly you can put them in." If, however, these additional directions fail to bring an appropriate response, the test is considered a failure. If the subject goes to work at once, the time is recorded by means of a stop watch from the moment he touches the first block until the last block is set securely into its proper recess. For the test to be completed correctly all the blocks must be set down firmly in their respective recesses; but a trial may be accepted as correct if only one block is left lying loosely, but turned correctly upon its recess, providing the other ten are set in properly. It is advisable to encourage and assure the subject of his success by saying, "That's right," as soon as he has all the blocks correctly replaced.

Second trial. This follows the completion of the first trial immediately without comment of any kind whatever. On this trial the test is presented to every subject not only with the same directions, but with the blocks in a set arrangement. The general principle of this arrangement is that the blocks shall not come in regular order, and shall not when removed be in the tray directly above their respective recesses. Since the experimenter, in repeating the test, tends unconsciously to fall into the habit of removing the blocks always in a certain manner, it seemed advisable to determine the proper course of this habit before it was formed and thereby be assured that it will not defeat its purpose. The following arrangement was therefore decided upon and rigidly followed:

The blocks are placed in the tray, arranged in three piles. One pile, set in the tray directly above recess number 1, contains blocks 5, 10, 7, and 8, numbering from the top of the pile downward. The second pile, placed in the middle of the tray, contains blocks 11, 2, and 9, numbering from the top downward. The third pile, placed in the tray directly above recess 9, contains blocks 1, 6, 4, and 3, numbering from the top downward. The blocks of each pile are picked up or removed from the recesses with one hand by taking them in the order of their numbers, as indicated above. Thus the first pile is formed by picking out block 5 and placing it on block 10, then picking up these two and placing them on block 7, then these three and placing them on block 8, and last of all picking up all four and placing them in the tray directly above recess number 1.

While the blocks are being removed in the manner described above, the experimenter says, "Now I am going to take the blocks out in this order (or a definite order) and I want to see if you can't put them in quicker.' Then when the blocks are all removed,

he spurs the subject on thus, "Now see how quickly you can put them in." The time is recorded in exactly the same manner as on the first trial. Unless all the blocks are correctly replaced without further suggestion the test is recorded as a failure.

Third trial. As soon as all the blocks are correctly replaced on the second trial, the following directions are given, "Now (or this time) you may take the blocks out to suit yourself, and see if you can't put them in still quicker." The subject is given unlimited freedom in the removal of the blocks and their arrangement, with the single exception that he is required to place them in the tray. As soon as he has removed all the blocks, he is urged to do his best by saying, "Now see how quickly you can replace them (or put them in)." The time is again taken as on the first trial, and the test is complete.

Quantitative Treatment.

Exactly the same method was employed in securing all the records treated in this monograph, and as far as uniformity can be obtained, the records of all the children tested are comparable. For various reasons beyond the control of the author, he cannot be personally responsible for the reliability of all the adult records, although he believes the errors are small, perhaps negligible.

The distinction between children and adults in this treatment is arbitrary, but justifiable. All college students and public school teachers are considered adults regardless of age. They make up nearly the entire adult group. Its age limits are very wide—from sixteen to sixty years.

All pupils of the public schools are considered as children, and are grouped according to sex and age. The children of this investigation constitute an unselected group of pupils from the regular classes of the Philadelphia public elementary schools. *Unselected* means that there was no selection on the part of the examiner, and that he tested all the children from the regular classes in those schools in which he did his testing. The schools in which the testing was done lie in two very different sections of the city. Of the first sixteen hundred children tested, about 75 or 80 per cent are of foreign parentage and live in the poorer sections of the city. The last twelve hundred children tested, with the exception of about 3 or 4 per cent, are of American parentage of the professional classes and live in one of the best sections of the city. These different sections were chosen in an effort to make the quantified results more typical and reliable.

Records eliminated. Although there was no selection of the

children to be tested, it was found necessary to make certain eliminations after the data had been collected. Eliminations were not made without abundant evidence of justification. In no case was a record excluded merely because the time record did not prove to be what the examiner expected.

The eliminations can roughly be divided into two general classes. The first contains those cases who failed to complete the test correctly without instructions other than the standard directions. These are eliminated because they failed to perform the test properly, and because the method of treating failures, that of giving the subjects help and then estimating the amount of help given, is unsatisfactory and does not lend itself to standardization. These cases are not comparable with those who did the test successfully, or even with one another. The only respect in which they are comparable is, that with a standard method and under standard conditions they failed to complete the test. Failure in this sense does not mean feeblemindedness. Just what it indicates cannot be determined without more extensive investigation and study. The number of failures for each age is given at the top of the table of distributions. Of these failures, 72 per cent occurred on the first trial only, 12 per cent occurred on the second trial only, while 11 per cent occurred on both the first and second trials, the third trial being a success. Failure occurred for the first time on the third trial in about 3 per cent of the cases. Two children failed on all three trials.

The second group of eliminations contains the records thrown out entirely from the above group and from the group who completed the test correctly. It includes the records of four children whose ages could not be verified, of one boy whose vision was so defective that it interfered seriously with his performance, of two children diagnosed as not higher than borderline cases, and four children diagnosed as feebleminded at the Psychological Clinic of the University of Pennsylvania.

As the result of questionable formboard performances, about twelve children have been examined at the Psychological Clinic. Of these, six, as indicated above, have been diagnosed as below normal, while the others have been pronounced normal. Of the six diagnosed as borderline cases and feebleminded, three failed and required help on at least one trial of the formboard test. None of the other three failed on any trial, but completed it successfully. The shortest trial of the girl diagnosed as a borderline case was 6 seconds longer than the maximum for her age. The other two who completed it without failure, but were diagnosed as feebleminded,

were boys. The shortest trial of the one was next to the longest record for his age; the shortest trial record of the other was within the upper or poorest 10 per cent for his age. It is therefore evident that some feebleminded children may pass the formboard test successfully, but so far as our experience goes do not win special honors. On the other hand, some normal children may fail to complete the test correctly on at least two of their three trials. This has been demonstrated by the fact that children who failed on the formboard test when it was given in the school have been diagnosed as normal by the Clinic. Of five such failures sent to the Clinic, and there diagnosed as normal, four failed on two of their three trials. It must be remembered that only those who made the worst failures were sent to the Clinic. Since some of those who make the worst failures prove normal, and some feebleminded, our position is definitely established that we do not know the significance of failure, but that it does not necessarily mean feeblemindedness. It appears that, if we must depend entirely upon time records or other quantifiable data in the treatment and interpretation of such cases, we are helpless.

Successful Performances.

This group includes the records of all the public elementary school pupils in regular classes tested, except those eliminated in the preceding section. It also includes the records of 221 adults.

All the records are classified according to the sex and age of the subject. Up to the end of the twelfth year, the classifications are by half-year groups, after that to the end of the sixteenth year by year groups, and lastly those from seventeen to the beginning of the nineteenth year are thrown into one group. In the charts and tables each age group is designated by the middle value of the group. Thus the group headed 6.25 includes all the children who are six years old, but less than six years and six months old, *i. e.* it ends with the end of the fifth month. Those who are six years and six months old, but less than seven years of age come in the group headed 6.75. The 13.50 group contains all children thirteen years of age.

No record was kept of the number or character of errors made by these children. The work of other investigators already referred to, shows the futility of such records, especially for normal children. At no time during this investigation has the need of such a record been felt. It is much more important to consider why a child makes errors than merely to know what errors he makes. If the examiner gives his attention to the number and kind of errors, he cannot study the performance analytically while it is in progress.

The only data uniformly collected from the performances of all the subjects tested, were the time records for each of the three trials. In some of the cases a record was also kept of those who removed and replaced the blocks according to some plan on the third trial. This latter feature was noted in an endeavor to determine the advisability and possibility of standardizing qualitative factors. It was found impossible in many cases to decide whether a subject intended to plan or if he just happened to remove the blocks according to a plan. In reality the easiest way to remove the blocks happens to be the best plan.

The shortest of the three trials is taken as the index of an individual's formboard ability. This is generally taken by other investigators as the most reliable single index. It is easily determined and lends itself readily to statistical treatment. So far as this investigation goes, it distinctly supports the earlier formboard studies which establish and adopt this as the most satisfactory basis for standardization. The shortest trial is here taken as the basis for the quantitative treatment of results.

Tables I and II contain the distributions of the shortest trial time records for each age group; table I for boys and table II for girls. Across the top of the table, opposite F on the ordinate, are the number of failures for each age. They are given merely to show their relative frequencies and distribution. Otherwise they have no relation or significance in the tables of distribution or their quantification. The numbers in parentheses, across the bottom of the tables beneath the ages, show the number of cases in each age group included in the distributions. They do not include the failures indicated above. These tables show the distribution of the time records in the different ages and the general tendency for them to shift downward toward shorter times with the increasing age of the subjects. They also show that in several ages there is one extra long time record and that in several others the range of distribution is unusually narrow. The explanation of this latter condition lies in the fact that not enough children have been tested in any age group to determine reliably and definitely the range of distribution within which the records of all normal children fall. It appears, however, that enough cases are here presented to indicate in a general way the tendencies of the various age distributions and their central values.

The range of distribution is wider and the standard deviations are larger for the records collected in this investigation than for those reported by any other investigator. Two factors are largely responsible for these differences. In the first place, the standard

TABLE I.—DISTRIBUTION OF SHORTEST TRIAL TIME RECORDS OF 1474 BOYS.

F	5	6	9	4	14	6	11	4	5	2	4	1		1	1	1					
92				1																	
67			1	1																	
60	1																				
59				1																	
58		1			2																
57																					
56																					
55			2			1															
54			1																		
53	1	1																			
52																					
51																					
50	1			1		1															
49			1																		
48						1															
47					1																
46				1		1			1												
45				2		1	1														
44			1		1	1		1													
43			1		1																
42		1				2	2														
41				1		1															
40						1															
39		1	2	1	2	4	1	1													
38			1		2			1						1							
37		1		1	3		1		1		1										
36			1	1		1	2		1	1											
35			1	3	1			2	2												
34			1		3	3	2		1		1										
33		1				3	2	3	3												
32			2	1	4	3	5	2		2		2									
31			1	1	2	4	4	3	4			2									
30			1	1	3	3	3	2		3	2		1				1				
29				2	4	3	4	2	1	2	2	2			1						
28				2	2	2	4	5	2	4		1	2	1							
27			2		5	5	3	2	4	3	1	1			1		1			1	
26			1	1	4		5	3	7	4	2	3	2			1	1		1		
25			1		1	1	14	5	8	4	3		5		1		1				
24					1	1	4	2	6	2	1	1	3	1	2		1				
23					1	9	6	6	3	8	4	3	2	3	4		3	4	3	1	1
22					2	3	3	6	10	7	13	7	6	3	4	1	5		1	3	1
21			1	2	2		6	8	2	6	6	6	3	3	4	3	3	3	7		
20			1		2	2	3	3	5	6	5	10	3	4	4	5	2	9	3	2	1
19						2		6	5	2	11	11	6	6	8	4	3	4	9	4	2
18								3	4	7	3	8	3	6	6	8	6	7	10	8	3
17						1		3	1	2	7	8	7	9	12	6	9	11	13	6	2
16								1	1	3	2	10	9	7	9	8	12	6	14	8	4
15								2	1	1	2	2	3	7	3	10	9	8	15	13	10
14										3	1	7	4	7	6	6	15	11	21	17	3
13										2	4	1	1	1	3	4	4	16	12	13	12
12												3	1	1	2	3	8	9	11	12	3
11													1	1	3		2	3	8	7	2
10														2			3	1	7	5	2
9																		1		1	1
8																			3	1	
7																					
6																					
	4.25	4.75	5.25	5.75	6.25	6.75	7.25	7.75	8.25	8.75	9.25	9.75	10.25	10.75	11.25	11.75	12.25	12.75	13.50	14.50	15.50
	(3)	(6)	(23)	(24)	(49)	(60)	(75)	(73)	(72)	(72)	(71)	(88)	(62)	(65)	(72)	(62)	(85)	(95)	(137)	(101)	(46)

F	16.50	18.00	Adult
92			
67			
60			
59			
58			
57			
56			
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29			
28			
27			
26			
25			1
24			
23			1
22			1
21			
20			1
19			1
18	1		1
17		2	4
16	2		3
15		1	9
14	2	1	10
13	2		7
12			12
11	1		23
10			24
9			15
8			6
7			3
6			
	16.50	18.00	Adult
	(8)	(4)	(121)

Ordinate: Time in seconds.
Abscissa: Age, middle value of.
F: No. of failures per age (excluded).
In parentheses: No. per age in distribution.

TABLE II.—DISTRIBUTION OF SHORTEST TRIAL TIME RECORDS OF 1375 GIRLS.

F	8	11	12	5	16	12	7	10	5	3	1	2	3	1	2	1	1	2	
103		1																	
86						1													
85		1																	
76					1														
71					1														
56							1												
55																			
54					1							1							
53	1	1			1														
52																			
51							1	1											
50	1				1														
49																			
48					1														
47		1	1		1	1													
46			1			1													
45					3		2												
44						1													
43		1			1	1													
42							1		1										
41	1	1				2		1											
40					1	1		1			1								
39								2											
38			1	1	1		1	1		1									
37			1		6	2	3							1					
36	1	1		1	1	1				1	1								
35		1	1	1		2		2			1								
34	1				1	1		2	3										
33			1	1	3	2	2	1		2	2	1			1				
32		1	1		1	3	2		2	1	2	2							
31				1	4	1	10	5	1			1		1	1				
30			1	1	3	3	4	4	1	2		2			2	1			
29			1		5	2	2	3	6	1		2			2	1	1		
28				1	1	3	5	2	1		1			1					
27				2	4	3	2	3	4	2		1	2		1	2		1	
26				3	1	5	6	7	2	4	1	2		2	5	1	1	1	
25			2	4	2	5	3	5	4	6	2	1	1	1	4	1		1	
24				1	2	1	5	8	8	2	7	2	6	1	1	1	2	1	
23				1	4		5	8	3	5	3	4		1	3	2	1	2	1
22		1			1	3	2	1	12	10	4	7	5	2	2	1	2	7	1
21				1			5	5	3		11	7	4	7	1	4	5	6	3
20						1	2	3	6	7	4	6	6	5	8	6	5	7	7
19							4	2	4	5	8	4	6	8	4	7	8	10	4
18							2	1	4	6	6	3	5	14	8	9	14	17	5
17								2	4	4	6	11	10	6	6	8	10	17	6
16				1					2	5	1	7	5	5	7	7	6	13	9
15									1	2	3	8	3	5	7	8	10	4	18
14										1	1	1	5	3	11	4	11	7	15
13										1			2	1	3	7	10	9	12
12									1		2		3		2	2	2	1	5
11														1			1		5
10																2	3	1	4
9																		1	1
8																			
7																			
6																			
	4.25	4.75	5.25	5.75	6.25	6.75	7.25	7.75	8.25	8.75	9.25	9.75	10.25	10.75	11.25	11.75	12.25	12.75	13.50
	(5)	(10)	(11)	(20)	(52)	(46)	(70)	(70)	(73)	(68)	(67)	(73)	(61)	(68)	(70)	(86)	(94)	(68)	(144)

F	1	1	2		
103					
86					
85					
76					
71					
56					
55					
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53					
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37					
36					
35					
34					
33					
32					
31					
30	1				
29					
28					
27	1				
26	1				
25	1				
24	1	3			
23	2		1		
22	7	1			1
21	6	3	2		
20	7	7	1		2
19	10	4			
18	17	5	1		1
17	17	6	2		4
16	13	9	3	1	6
15	18	8	5	4	1	7
14	15	6	6	3		6
13	12	8	3	4	1	17
12	5	5	1	1	1	14
11	5	3	2			23
10	4	1	1	1		7
9	1	1				6
8		1				5
7			1	1		1
6						1
	13.50	14.50	15.50	16.50	18.00	Adult
	(71)	(29)	(15)	(4)	(100)	

Ordinate: Time in seconds.
Abscissa: Age, middle value of.
F: No. of failures per age (excluded).
In parentheses: No. per age in distribution.

TABLE III.—TIME VALUES AND NUMBER OF CASES OF DIFFERENT AGES—BOYS.

Age	Number of Cases	Mean	Standard Deviation	Minimum	Lowest Quintile	Lower Quintile	Median	Upper Quintile	Highest Quintile	Maximum
6.25	49	31.4	8.29	20	26	28	30.0	32	37	58
6.75	60	31.2	8.47	17	23	28	29.7	31	39	55
7.25	75	27.5	5.41	20	23	25	26.0	28	32	45
7.75	73	24.9	6.43	15	19	22	23.3	25	31	46
8.25	72	24.5	5.01	15	20	22	24.2	25	28	37
8.75	72	22.3	4.91	13	18	21	22.1	23	27	36
9.25	71	20.9	4.70	13	17	19	20.6	22	23	37
9.75	88	19.5	4.50	12	16	18	19.0	20	22	32
10.25	62	19.4	4.28	11	16	17	18.8	20	23	30
10.75	65	18.0	4.57	10	15	16	17.3	18	21	38
11.25	72	17.7	3.47	11	14	17	17.4	18	21	26
11.75	62	17.1	3.30	12	14	16	16.6	17	20	27
12.25	85	16.1	3.56	10	13	15	15.7	16	19	30
12.75	95	15.9	3.64	9	13	15	15.4	17	19	26
13.50	137	15.2	3.23	8	12	14	15.0	16	18	23
14.50	101	14.5	3.00	8	12	13	14.2	15	17	23
15.50	46	14.6	3.05	9	13	13	14.5	15	16	27
Adult	121	11.8	2.96	7	9	10	11.1	15	16	23

TABLE IV.—TIME VALUES AND NUMBER OF CASES OF DIFFERENT AGES—GIRLS.

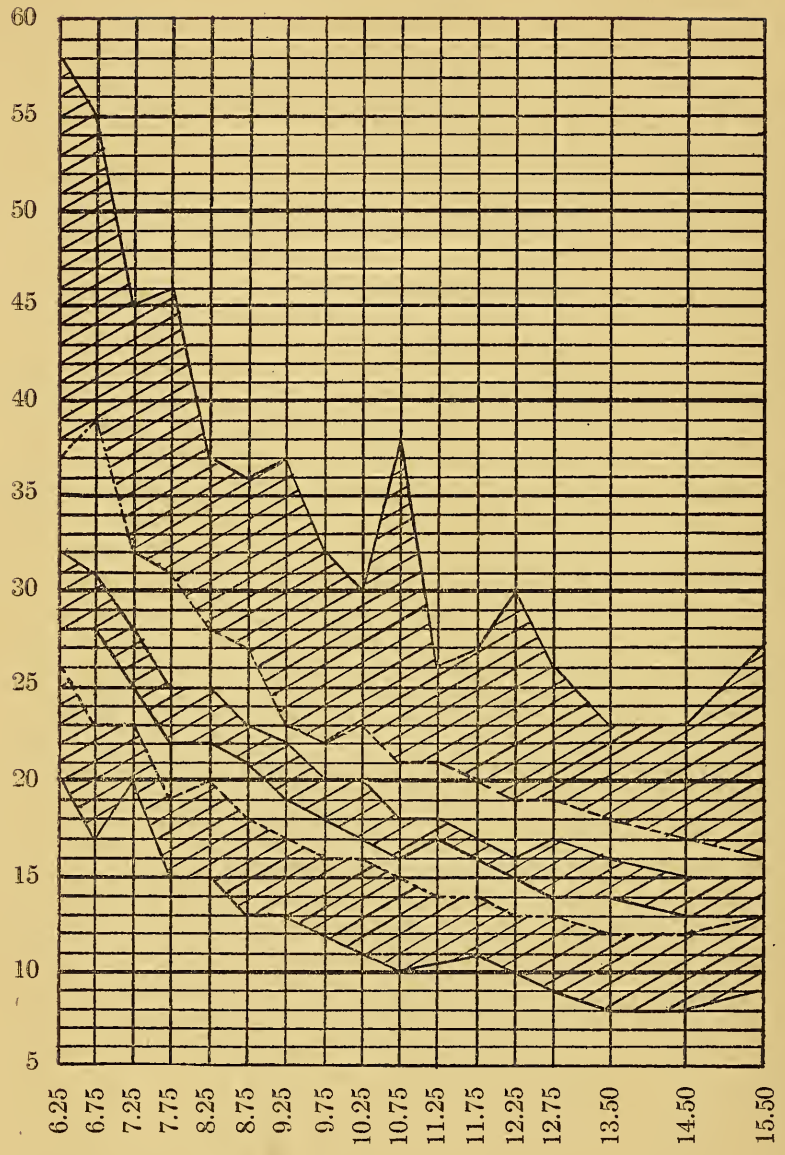
Age	Number of Cases	Mean	Standard Deviation	Minimum	Lowest Quintile	Lower Quintile	Median	Upper Quintile	Highest Quintile	Maximum
6.25	52	34.8	11.21	22	26	29	31.4	33	40	76
6.75	46	32.0	10.43	20	25	27	29.3	30	37	86
7.25	70	28.1	7.41	18	22	25	27.3	29	31	56
7.75	70	26.8	6.13	17	22	24	25.6	26	31	51
8.25	73	23.5	4.94	12	19	22	22.5	24	28	42
8.75	68	22.0	5.21	13	18	20	21.4	23	26	38
9.25	67	21.5	5.48	12	18	19	20.8	21	24	40
9.75	73	20.9	4.75	14	16	18	20.0	21	23	54
10.25	61	18.3	3.39	12	15	17	18.1	19	21	25
10.75	68	19.4	4.36	11	16	18	18.5	19	21	37
11.25	70	17.8	3.68	12	14	16	17.4	18	21	27
11.75	86	19.0	5.04	10	15	17	18.1	19	23	31
12.25	94	17.0	3.76	10	14	16	17.0	18	20	29
12.75	68	17.2	3.53	9	14	16	17.3	18	20	29
13.50	144	16.6	3.61	9	14	15	16.5	17	19	30
14.50	71	16.0	3.53	8	13	15	15.8	16	20	24
15.50	29	14.9	3.37	7	13	14	14.7	15	17	23
Adult	100	12.3	2.72	6	10	11	12.1	13	14	22

method of giving the test permits the expression of greater individuality on the part of the subject. It is less mechanical and allows him more freedom in the employment of his own resources. In the second place, the scope of the investigation is larger and includes a relatively wider range of individuals, being made up of children from both the better and the poorer districts of the city. Had the investigation been confined to either of these districts alone, a distinctly different distribution of records would have resulted. The standard deviations would then be considerably smaller than they are under the present distribution. The central values of the records from the better districts of the city are distinctly below those from the poorer sections. The maximum record for each age group was made in 87 per cent of the groups of girls and 83 per cent of the groups of boys, by children from the poorer sections of the city; while the minimum record for each age group was made in 87 per cent of the groups of girls and 70 per cent of the groups of boys, by children from the better sections of the city. This is not an attempt to contrast the better sections of the city with the poorer sections, but a practical demonstration of the pitfalls, and the impossibility of establishing reliable norms by testing only a couple of thousand children. It is absurd to label as a standardization the results obtained by testing only several hundred children.

Tables III and IV contain the computed results of the distributions of the time records for the ages in which the number of cases tested is sufficient to warrant a reasonable confidence in their reliability. Table III contains the records of the boys, and table IV those of the girls. In both tables the first column indicates the ages, the second the number of cases for each age group, and the remaining columns represent time values in seconds as calculated from the records for each age. The third column contains the mean time and the fourth the standard deviations. The fifth contains the lowest, *i. e.* shortest, or minimum record for each age; the sixth column, the lowest quintile, or the value of that record below which 20 per cent of the cases are distributed; the seventh column, the lower quintile, or that value below which 40 per cent of the cases are distributed; the eighth column, the median, or that value above and below which 50 per cent of the cases are distributed; the ninth column, the upper quintile, or that value above which 40 per cent of the cases are distributed; the tenth column, the highest quintile, or that value above which 20 per cent of the cases are distributed; the eleventh column, the maximum or longest record made by any individual of the group.

The central values, as indicated by the relatively large standard

CHART I.—BOYS.


60
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6.75
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7.75
8.25
8.75
9.25
9.75
10.25
10.75
11.25
11.75
12.25
12.75
13.50
14.50
15.50

CHART II.—GIRLS.

deviations, especially for the lower ages, are only approximately reliable and are not presented as absolute and final norms. By this we mean, that these values do not determine the standard of normality so accurately that a child in order to be considered normal must perform the test in exactly mean or median time; or stated inversely, that a child who performs the test in a given length of time has the mentality of that age for which his time happens to be the mean or median value. In contradistinction to what certain published reports would have us believe, it must be remembered that neither normality nor mentality, whatever they are, can be represented by a point, or rated by reference to any absolute standard.

A graphic representation of the distribution of the time records of the children in tables III and IV is given in charts I and II. On the abscissa are the ages, and on the ordinate, the time in seconds. The lowest shaded portion is bounded by the minimum and lowest quintile. It contains the time records of the lowest 20 per cent of all records. The middle shaded portion, bounded by the lower and upper quintiles, is known as the middle quintile and contains the middle 20 per cent of the records, 40 per cent lying above and 40 per cent below. The uppermost shaded portion, bounded by the highest quintile and the maximum for each age, contains the highest 20 per cent of all records. The unshaded portions bounding the middle quintile each contain 20 per cent of the records.

Reference to these tables and charts shows (1) that formboard ability increases at least to the age of fifteen; (2) that half-yearly norms are not only possible, but necessary, up at least to the age of thirteen, if a standardization is to have practical value; and (3) that boys are on the average superior to girls in the test. The actual value and extent of the differences here enumerated and established can be determined only by continued application of the test to many more hundreds of children. Until such an extension is made these tables and charts will have to serve as the basis of comparison for records obtained with the use of the same board by the same method.

The most expeditious way of using the charts to compare a given record, is to refer the record first to its proper sex and age group. Its relative position within this group should then be determined by locating it with reference to the quintile within which it falls.

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